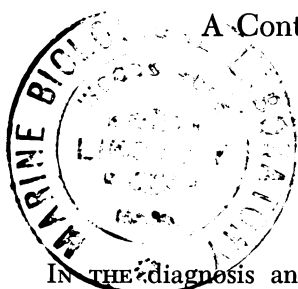


Cervical Diskography *

A Contribution to the Etiology and Mechanism of Neck, Shoulder and Arm Pain

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IN THE diagnosis and treatment of patients with symptoms of pain in the neck, upper back, shoulder and arm following an injury to the cervical region, physicians constantly are aware that there are a great many unknown factors in the cervical syndrome. In the absence of objective evidence to substantiate the patient's complaints of pain, a diagnosis of psychoneurosis or malingering is often made unjustifiably. Mr. W. Scott Allen, Vice President of the Liberty Mutual Insurance Company, in a discussion of the medico-legal aspects of injuries to the cervical spine, made the following statement: "Cervical trauma is one of those areas of physical injury which, like head and back injuries, often results in subjective complaints that are extremely difficult for the courts, industrial commissioners, insurance carriers and attorneys to properly evaluate. Leading neurological and orthopedic specialists tell us that there is still much that is unknown about the pathology of cervical trauma, that many times they do not know exactly what to look for in injuries to this area, and that they usually cannot deny subjective complaints in view of the lack of precise information. Undoubtedly, present and future research projects in this field will provide criteria for the attending physician or the examining physician which will permit more accurate appraisal."¹ There is need

for an objective diagnostic procedure to aid in differentiating between symptoms due to organic changes in the cervical region and those having a functional basis.

This report describes the procedure of cervical diskography which has been employed for the last three years in the diagnosis of patients having neck, shoulder and arm pain. This experience has resulted in the accumulation of some precise information which has been of considerable value in elucidating the origin, etiology and mechanism of these pains. It is generally accepted by most physicians that symptoms of pain in the neck, shoulder and arm following a cervical spine injury can result from two pathologic processes: (1) a tear or disruption of the ligaments and muscles of the neck; or (2) an injury to the intervertebral disk with involvement of the corresponding nerve root. In the presence of bony changes in the cervical vertebra indicative of disk degeneration (cervical spondylosis), differentiation between these two pathologic conditions is particularly difficult. It has been determined recently that many pains referred to the neck, shoulder and upper extremities have their origin within the cervical intervertebral disks and their surrounding ligaments. This information has been obtained as a result of direct stimulation by cervical diskography and open operation. The location and distribution of the pains thus produced will be described, as well as the new method of surgical treatment mentioned.

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It is common knowledge that pain in the neck, shoulder and arm is almost always an integral part of the syndrome of the ruptured cervical disk. Pains in these regions are attributed by most neurologists to compression of the nerve roots by a herniated disk or associated bony osteophyte. These symptoms, however, frequently precede the radiation of pain into the forearm and hand by weeks or months, or they may exist without neurological evidence of involvement of the sensory root.

Early reports in the medical literature on the cervical disk syndrome by Stookey,²¹ Michaelson and Mixter,¹⁴ and Elliot and Kramer⁴ bear out this fact. The only pain common to all patients described was that located in the region of the scapula. It could be induced by local pressure and relieved by novocaine injection. Paresthesias and often muscle spasm at the site of pain were encountered in each case. None of these authors was able to explain the cause and origin of the pain. Electromyographic investigation of the painful area in the scapula associated with cervical disk lesions was reported by Wedell and Feinstein.²³ They demonstrated a constant increased irritability of the local muscles in the tender area, indicating continuous involuntary muscle spasm. They concluded that "spasm was not induced by a lesion of the painful nerve root, but by a secondary source of pain," the origin of which is obviously unknown.

It is apparent from these observations that the exact nature of pain referred to dermatome areas of the body not supplied by the involved cervical nerve root is not well understood. The skin over the so-called trigger zone along the vertebral border of the scapula is supplied by the 2nd to the 7th thoracic nerve roots. Muscles beneath these areas, however, receive their nerve supply from lower cervical nerve roots of the brachial plexus. The levator scapulae muscle is supplied by C3 and C4, the rhomboids by C5, supra and infra

spinatus muscles by C5 and C6, and the subscapularis and latissimus dorsi by C6 and C7. These muscles are all attached to, or located in the region of, the vertebral border of the scapula. It is probable, therefore, that the scapula pain associated with lower cervical disk lesions is a motor phenomenon rather than sensory. Pain results from reflex spasm of muscles supplied by the cervical nerve root which may be effected by cervical disk lesions. Since the neck, arm and shoulder pain associated with cervical disk pathology usually precedes clinical evidence of nerve root involvement, a source of pain other than direct compression of the motor root, the sensory nerve root or spinal root ganglion by the herniated disk must be sought. A possible explanation of the origin and distribution of these pains has been discovered by applying the procedure of diskography in the diagnosis of ruptured cervical disks.

Diskography is a radiographic visualization of an intervertebral disk by the injection of an opaque solution into it. The method was first used by Schmorl in 1929,¹⁷ and presented for clinical diagnosis by Lindbloom in 1948.¹¹ Surgeons have been reluctant to accept diskography as a routine diagnostic procedure because of fear of injury to a normal disk by inserting a needle into it.

Diskography has been used in my clinic as a routine procedure in the diagnosis of most ruptured lumbar disks since 1950. Over 450 lumbar diskograms have been performed in this eight-year period. This volume of clinical material has been utilized to study pathology and symptomatology of lumbar disks. A great deal has been learned about functional anatomy and pathologic physiology of the diseased disk. Injection and roentgenographic visualization of the internal anatomy of the disk gives positive information which cannot be determined by clinical, radiologic or anatomic studies or by any other diagnostic

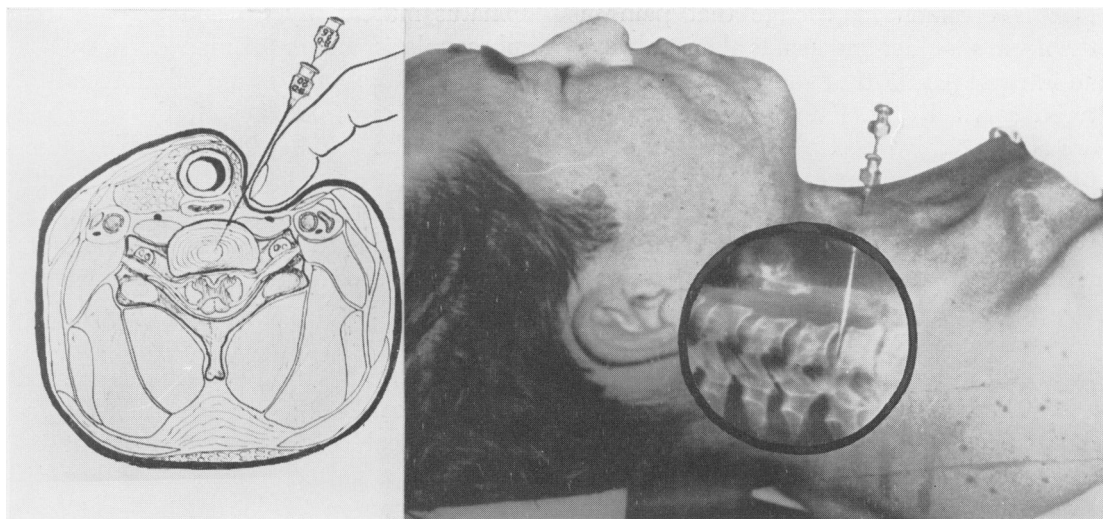


FIG. 1. Cervical diskography demonstrated by composite photograph. Insert drawing shows method of disk puncture.

procedure. Fear of injury to a normal disk by needle puncture has been proved to be unfounded. No case of rupture of a normal intact disk following diskography has been encountered in this series of cases. The most valuable use of lumbar diskography has been the study of pain. It was recognized early that clinical symptoms of low back pain radiating into the hip and thigh resulting from disk disease could often be reproduced when the abnormal disk was injected. This finding was soon utilized as a diagnostic test to determine the normal from the pathologic or symptomatic disk. Diskography has long been an indispensable part of our diagnostic armamentarium in the investigation and treatment of low back pain due to lumbar disk lesions.

Information obtained from the study of lumbar disks by diskography was a stimulus to the development of a similar procedure for cervical disks. In February 1956, a method was developed for performing a cervical diskogram.² In the last three years 114 patients have been studied by cervical diskography. An analysis has been made of two factors which have given

much helpful diagnostic information in the lumbar region: (1) abnormalities of the intervertebral disk were demonstrated radiographically after the disk was injected; (2) the type and distribution of pain resulting from the injection was ascertained. Then the correlation between the patient's pain and the roentgenographic findings was made.

Cervical Diskography

The technic of cervical diskography consists of inserting a needle into the intervertebral disk from its antero-lateral surface. By applying deep digital pressure between the trachea and carotid artery, the anterior surface of the vertebral bodies can be palpated easily at a depth of less than 1 cm. (Fig. 1).

The two-needle technic is used. The first needle, a #20, 2 inches long, is inserted diagonally into the outer antero-lateral fibers of the annulus fibrosus of the disk. Through this guide a second fine 21½ inch (#25) needle is inserted into the center of the nucleus pulposus. The positions of the needles are determined radiographi-

cally. The solution used for visualization of the interior of the disk is 50 per cent Hypaque. Only 0.2 cc. to 0.3 cc. of the radio-opaque solution can be injected into a normal cervical disk. The procedure is carried out in the x-ray room. A small amount of novocaine in the skin is the only anesthetic used. With the patient conscious and cooperative, he can inform the operator as to the location of the pain when the needles are inserted and the injection made.

The nature and location of pain reported by the first patient subjected to cervical disk puncture was so unusual that a careful statistical study of these cases was made in the hope that more could be learned about the pain syndrome associated with cervical disk pathology. From this study, a classification was made of the pains referred to remote parts of the body resulting from stimulation or irritation of the disk when injected. Six different locations from which pain can be elicited were demonstrated within the confines of the cervical disk or parts of the nervous system adjacent to the disk. The exact origin of each pain was verified subsequently by direct stimulation of the various areas exposed at operation in conscious and cooperative patients. The pains were classified into two general groups:

1. Pains induced by stimulation of the disk itself and its surrounding ligaments. These are referred to as diskogenic pains and are divided into two groups according to the location of the lesion: those originating from (a) anterior and antero-lateral areas of the disk; and (b) posterior and postero-lateral regions.

2. Pains resulting from irritation or stimulation of elements of the nervous system and their coverings adjacent to the disk. These are called neurogenic pains and are produced by stimulation of: (a) the nerve root; (b) the dural sheath of the root; (c) the spinal cord.

Diskogenic Pains

a. Anterior and antero-lateral disk pain:

The technic of cervical diskography was worked out originally on several fresh cadavers to develop proficiency in placement of the needle and to become acquainted with the radiographic findings of the normal and abnormal disks after injection with an opaque solution. When the procedure was tried out on the first patient, using local anesthesia in the skin only, she complained bitterly of pain when the needle made contact with the anterior surface of the intervertebral disk. When asked to localize the pain, the patient replied: "In my right shoulder blade." Repeated light jabs made with the needle along the anterior surface of the vertebral body caused little discomfort, but when the needle touched the anterior surface of the disk, pain was experienced immediately. The pain was invariably referred to the region of the vertebral border of the ipsolateral scapula (Fig. 2). A small amount of novocaine injected through the needle into the painful region immediately abolished the scapula pain. In the many cervical diskograms which subsequently have been performed, this has been a consistent finding.

When it was positively established that stimulation of the anterior surface of the cervical disk resulted in pain referred to the region of the scapula, a systematic study was made of each of the lower cervical disks. The pattern of referred pain was constant whether the stimulus was produced by needle puncture on the external surface of the disk or by focal internal pressure by injection of an anterior ruptured disk for diskography. The patient described the pain as a deep, dull ache in the shoulder blade—not a sharp pain—although sometimes quite intense. It was of only momentary duration when produced by needle puncture or by local pressure at operation. When caused by disk injec-

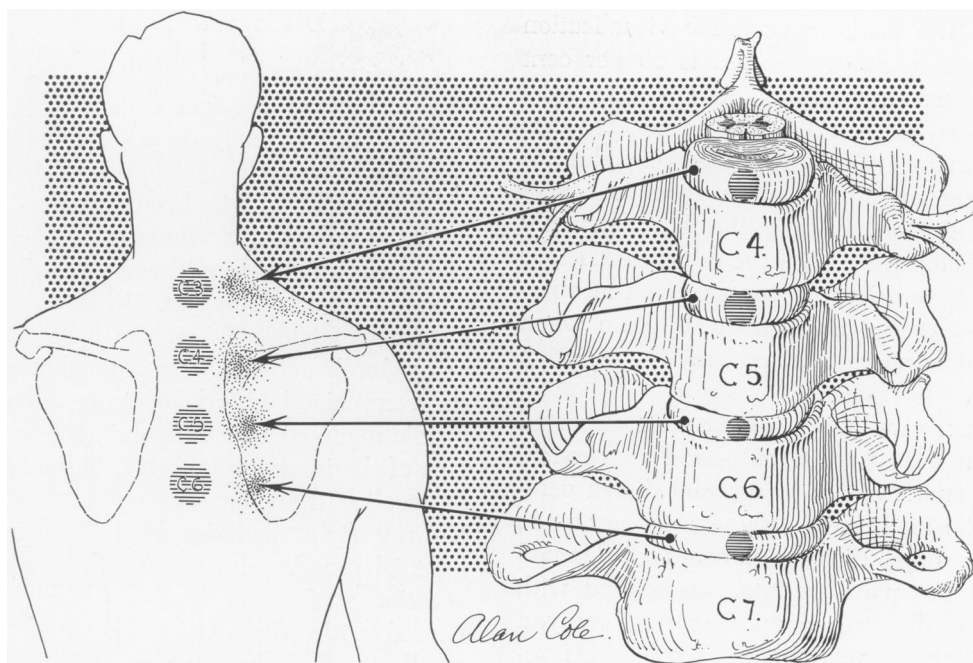


FIG. 2. Diskogenic pain: Referred from anterior surface of lower cervical disks.

tion, the pain continued for five to ten minutes. In not a single case did acute pain last longer than a few minutes.

At operation under local anesthesia the anterior surface of the lower cervical disks was stimulated by pressure with a blunt instrument and a weak electric current. When the disk was stimulated in the exact center, i.e., in the midline, the patient localized the pain in the "middle of the back" or "between my shoulders on both sides" (Fig. 2). When the stimulus was applied laterally to the midline of the disk, even as little as 2 or 3 millimeters from the midline, the pain was localized immediately at the "shoulder blade" on the same side. The unilateral pain along the vertebral border of the scapula was located in a focal area about the size of a silver dollar. When the C6-7 disk was stimulated, pain was referred to the region of the inferior angle of the scapula. Pain from the C5-6 disk was felt in the approximate center of the scapular border; pain from the C4-5 disk was

experienced in the region of the spine and superior angle. The C3-4 disk referred pain to the level of the C7 spinous process with a spread on top of the shoulder and the posterior border of the trapezius muscle. These regions overlap considerably in different patients, but stimulation of the lower cervical disk produced pain more caudad and in the upper cervical disks superiorly along the scapular border (Fig. 2).

b. Posterior and postero-lateral disk pain: Referred pains originating from the posterior surface of the cervical disk and the posterior longitudinal ligament have not been localized as accurately as those of the anterior surface. Stimulation of these regions is also accomplished by irritation from injection of the disk for diskography, and by direct stimulation, when exposed for operation by the anterior approach.³

When an extensively ruptured or degenerated disk is injected, stimulation produced by pressure of the injected solution may be transmitted simultaneously to both

the anterior and posterior surfaces of the disk. It is difficult, therefore, to determine the origin of the pain. A small amount of novocaine is injected through the first diskogram needle in the hope that the anterior elements only will be anesthetized. The pain resulting from the injection is then referred to the posterior regions. At operation when novocaine is injected into the anterior surface of the disk in preparation for surgical opening of the bone, the anesthetic seems to diffuse immediately through the disk, anesthetizing both the anterior and posterior elements. Thus, direct stimulation of the posterior structures, by the time they are exposed, produces very little pain. If disk rupture is confined only to the posterior or postero-lateral fibers, the true picture of referred pains from this region can be determined when the disk is injected.

Referred pains from the posterior surface of the lower cervical disks are localized by most patients to any one or a combination of the following sites:

1. "The upper shoulder blade" (region of the superior angle of the vertebral border of the scapula);
2. "At the base of the neck" (region of first thoracic spinous process);
3. "The top of the shoulder" (along the anterior border of the trapezius muscle);
4. "The point of the shoulder" (shoulder joint);
5. "The upper arm as far as the elbow."

A segmental differential of this flood of pain according to the cervical disk stimulated has been determined in a small number of patients whose disk rupture was confined to the posterior half of the disk. Distribution of pain is similar to that resulting from stimulation of the anterior surface of the disk, i.e., the point of maximum intensity of pain is located inferiorly along the vertebral border of the scapula when the

lower disks are injected, and more superiorly when the upper disks are injected. This pain differs from the anterior disk pain, however, in that it does not remain localized at the vertebral border of the scapula but spreads out in a fan-shaped band over the scapula and into the upper arm. This wider distribution and greater intensity of pain referred from the posterior surface of the ruptured disk, when injected, may be due to stimulation of more nerve endings than are found in the periphery of a normal disk. The presence of a greater number of nerves in a ruptured disk has been proposed by Hirsch and Schajowicz.⁸ They maintain that vascularized granulation tissue which invades the ruptured disk from the periphery may be accompanied by numerous proliferating nerve endings.

Postero-lateral disk protrusions: If the patient's clinical symptoms are unilateral, i.e., if pain is located on one side of the neck and radiates into the upper extremity, pain induced by injection will always be referred to the involved side. In unilateral disk rupture at C4-5, pain from the injection spreads out in a band from the "base of the neck" and "top of the shoulder" on the involved side and seldom spreads beyond the shoulder joint. Following injection of the two lower disks, C5-6 and C6-7, the pain is experienced over the scapula, across the shoulder joint, and along the lateral or posterior regions of the upper arm as far as the elbow (Fig. 3A).

Midline posterior disk protrusions: These are usually associated with osteophyte formation. Pain from the four lower cervical disks is referred to the midline posteriorly, in the back of the neck and upper shoulders. It is confined to an area overlying the 5th cervical to the 2nd thoracic spinous processes near the midline—upper disks cephalad and lower more caudad (Fig. 3B). In extensively ruptured and degenerated disks, the same type and distribution of pain is experienced simultaneously on

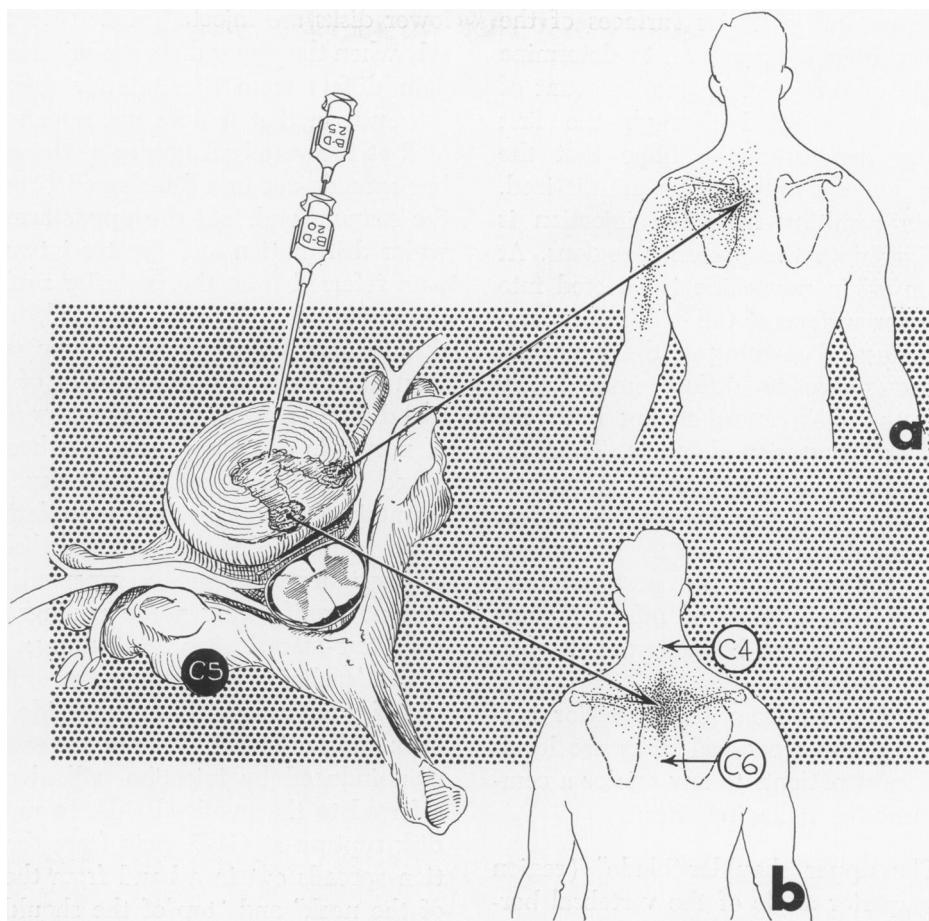


FIG. 3. Diskogenic pain: a. Referred from postero-lateral surface of cervical disks. b. Referred from central disk ruptures.

both sides, usually with expansion into both shoulders and arms.

Pain in the shoulder or neck, upper arm, or all three was the chief complaint of patients from whom the above information was obtained, both through diskography and at operation. These patients did not have pain radiating into the hand and fingers associated with numbness and paresthesias. This is the *Diskogenic Syndrome* since the pain has its origin within the intervertebral disk and the ligaments which surround it. The anatomic structures whose sensory nerves are responsible for the referred pain include the anterior and posterior longitudinal ligaments and the

peripheral layers of the annulus fibrosus of the disk.

Neurogenic Pains

Intervertebral disk protrusions or posterior marginal osteophytes may encroach upon the spinal canal either: (a) in the postero-lateral or infraforaminal position resulting in irritation and impairment of function of the overlying nerve roots (Fig. 4A); or (b) in the midline or just lateral to the midline, producing direct pressure upon and functional involvement of the spinal cord (Fig. 5A). Pains originating from nerve root or spinal cord experienced by the patient clinically and reproduced by

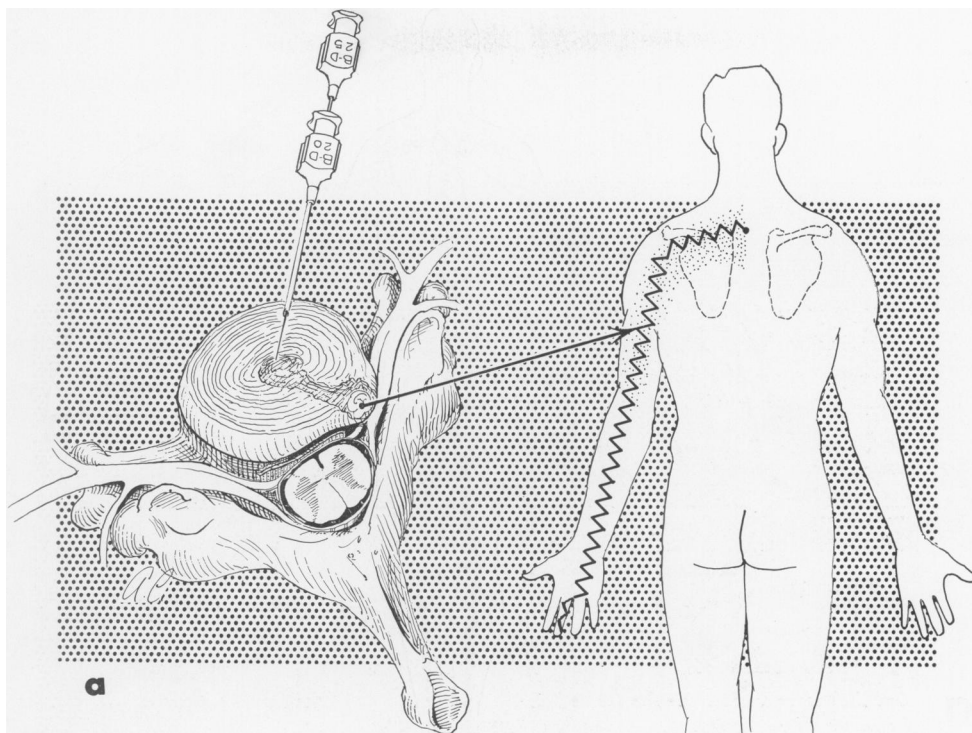


FIG. 4. Neurogenic pain: A. Nerve root compression by postero-lateral or infraforaminal disk protrusion.

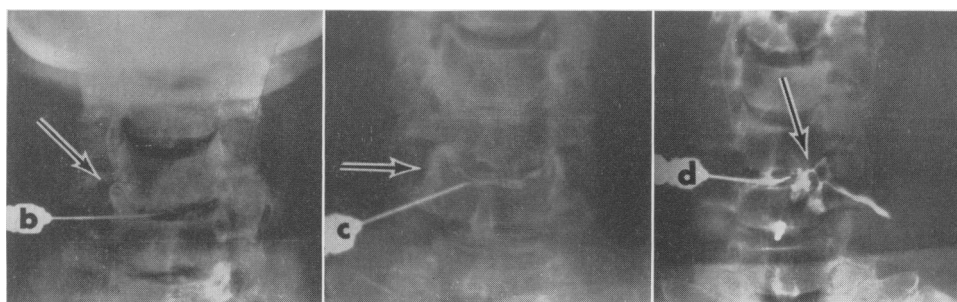


FIG. 4B. Cervical diskogram: Postero-lateral (soft) protrusion with annulus intact. C. Postero-lateral disk rupture through annulus. D. Unilateral rupture with intraspinal herniation of disk fragments.

diskography have been called *Neurogenic Pains*.

a. Nerve root pain: If the patient's clinical picture is that of unilateral brachial neuralgia or radiculitis indicating involvement of a single nerve root, injection of the disk for diskography may reproduce the neuralgic pain. Pressure transmitted through the herniated disk fragment to the

nerve root may cause a sharp lancinating pain extending below the elbow into the forearm and hand. One patient with such a syndrome described the pain produced by the injection as intense and described a feeling as though "hot lead had run down my arm and out the tip of my index finger." This type of pain was encountered in patients in whom fragments of disk material

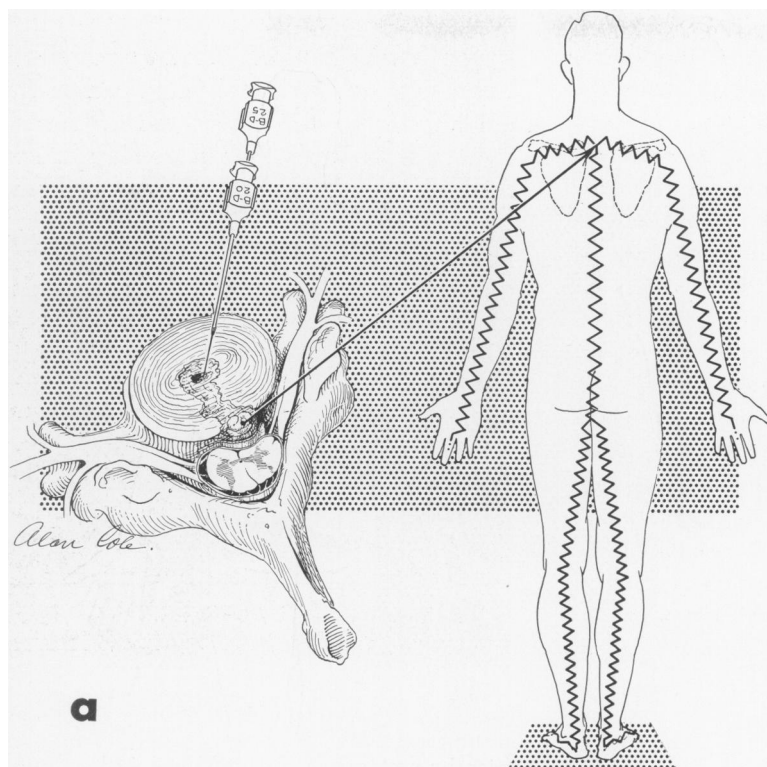


FIG. 5. Neurogenic pain: A. Spinal cord compression by midline intraspinal disk protrusion.

had herniated through a defect in the annulus, becoming lodged beneath the nerve root to cause nerve root compression. Disk injection increases the nerve root pressure and intensifies the pain; the diskogram outlines the herniated fragments (Fig. 4D). This is the "soft disk" of Scoville and Spurling.¹⁸

However, our experience with cervical diskography has shown that only rarely do patients with pain and paresthesias extending to the hand and fingers experience an intensification of pain when the disk is injected. In most patients with clinical evidence of unilateral nerve root involvement, pain referred from disk injection does not extend below the elbow. Upper arm pain is described as a severe aching sensation rather than a sharp lancinating pain. It is presumed that this pain has its origin in the annulus fibrosus of the disk or the posterior ligaments (a diskogenic or ligamentous

pain). The diskogram in these patients shows unilateral spread of opaque solution collecting as a round smooth knob posterolaterally beyond the limits of the intervertebral disk (Fig. 4B). The herniated disk fragments are outlined beneath the nerve root. Pressure of injected solution may not be transmitted to the nerve root sufficiently to cause nerve pain because a thin membrane of the posterior fibers of the annulus remains intact. Pain which results from stretching this thin membrane has the quality of a diskogenic pain.

b. Dural sheath pain: This pain has the quality of a diskogenic pain and possibly may originate in the dural sheath of the nerve root which is stimulated by disk injection, rather than compression of the nerve root itself. Falconer, *et al.*,⁵ have shown that stretching the dural sheath by angulation of the nerve root over a markedly protruded lumbar disk may cause re-

ferred pain in the hip and thigh. If cervical diskogram shows that opaque solution has escaped from the intravertebral space into the spinal canal or laterally along the nerve root, a laceration or defect in the posterolateral fibers of the annulus is indicated (Fig. 4C). Thus, referred diskogenic pain can originate in the annulus as injected solution passes through the laceration, or the dural sheath of the nerve root may be irritated as fluid surrounds and follows the nerve; or the pain may possibly have its origin in the motor nerve root. Frequently a patient with this type of disk rupture will experience increased numbness and paresthesias of the involved thumb and fingers at the time of injection, but associated pain does not extend below the elbow.

c. Spinal cord pain. Another type of pain encountered in cervical diskography is that resulting from a midline lesion projecting backward into the spinal canal and encroaching upon the spinal cord. This lesion may be a hard, bony osteophyte visible in

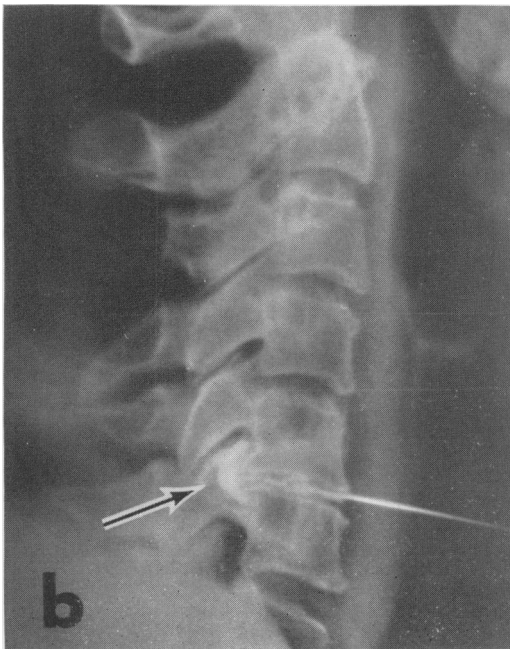


FIG. 5B. "Mushroom" protrusion of degenerated cervical disk about large posterior osteophytes.

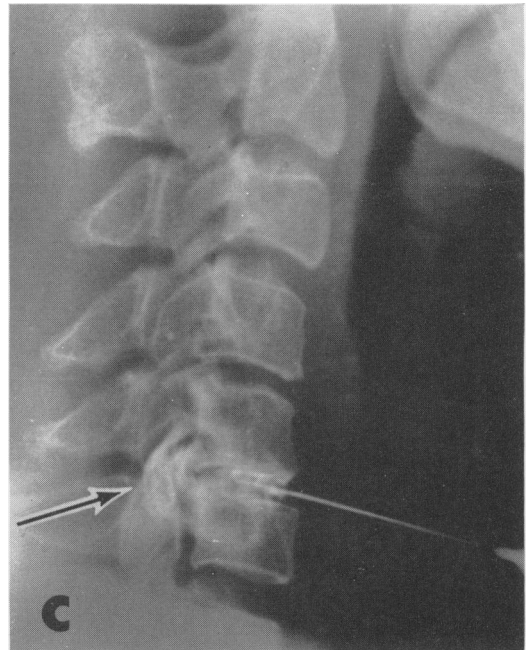


FIG. 5C. Massive intraspinal herniation of cervical disk with spinal cord compression and quadriplegia.

the plain roentgenogram or a large soft tissue mass outlined by the diskogram or myelogram. There may be a clinical picture of impairment of function of the spinal cord as evidenced by bilateral Babinski signs and spasticity of the lower extremity; or there may be local muscle atrophy in the upper extremities due to involvement of the anterior spinal artery and its branches. This syndrome is often referred to as pseudo amyotrophic lateral sclerosis. The character of the pain experienced when the disk is injected depends upon the size of the lesion. A small midline protrusion often causes no pain or mild discomfort in the "back of the neck" (Fig. 5B). In larger lesions, particularly massive intraspinal disk herniation, fluid injected into the disk escapes into the spinal canal and increases pressure upon the spinal cord. Four patients with a clinical picture indicating impairment of spinal cord function are included in this series of cervical diskograms. All four experienced sudden sharp pain de-

scribed as "an electric shock" when the disk was injected. The pain spread downward into both shoulders and arms and then down the middle of the spine. In one patient pain extended to coccyx. In another who had a quadriplegia from massive disk protrusion (Fig. 5C) the shock of pain spread down the spine into both lower extremities and "out my big toes." These are pains of acute spinal cord compression. Direct irritation of the long sensory pathways in the spinal cord produces the picture described originally by L'Hermitte (L'Hermitte's sign) and more recently by Tarlov.²²

Discussion

The above description of the various types and locations of pain resulting from cervical disk injection for diskography constitute all the information on pain which we have been able to discover by this procedure. Conspicuous by their absence are pains radiating into the precordium or suboccipital region, headaches and pain referred to the face and jaw; all of which have been attributed to the cervical intervertebral disk. Semmes and Murphey in 1943¹⁹ and Josey and Murphey in 1946¹⁰ pointed out the similarity between the syndrome of cervical disk and coronary heart disease. From my clinical experience precordial pain has not been encountered as a part of the cervical disk syndrome. In doing cervical diskograms and stimulating the disk at operation, every patient has been asked if he experienced pain in the anterior surface of the chest. As yet, none has described or admitted to pain in this location. The only "anterior" pain described by these patients has been located in the neck, i.e., in the skin and anterior neck muscles, the site of the needle puncture.

Raney, *et al.*,¹⁵ and Mayfield¹³ have indicated that intervertebral disk lesions in the lower cervical spine frequently are associated with headaches radiating into the occipital region, the frontal area, and often

are associated with nausea. All patients have been carefully interrogated as to whether or not the pain resulting from the disk injection radiated upward along the back of the neck and into the head or face. Only one patient in our series complained of pain in this location. She had had a cervical spine injury in an automobile accident with litigation pending. She was highly neurotic and had a true left occipital neuralgia with swelling of the greater occipital nerve. For these reasons, the patient's statement that the pain in her occipital region was intensified when the 5th cervical disk was injected could be questioned.

Anatomic Considerations

Sensory innervation of posterior elements of the spinal column was first described by Lushka in 1850.¹² He demonstrated a special recurrent nerve from the spinal root ganglion and sympathetic chain supplying the capsular apparatus, ligaments, periosteum and a section of the posterior longitudinal ligament. He called it the *Sinu-Vertebral Nerve*. This nerve has been studied by many investigators,^{7, 9, 16, 20, 24} but they cannot agree on its exact course and distribution. Sensory nerve supply to the anterior surface of the intervertebral disk and anterior longitudinal ligament has not been described. It is anatomically possible that branches of the sinu-vertebral nerve completely surround the intervertebral disk and supply these anterior structures. Such an innervation would explain the similarity of location and distribution of referred pains obtained from the anterior and those from the posterior surface of the cervical disk. When the midline of the disk is stimulated anteriorly, pain is felt bilaterally in the center of the back. This would suggest an overlapping of the nerves as they terminate in the midline on the anterior surface of the disk.

Scapular pain induced by stimulating the cervical disk is similar in character to the

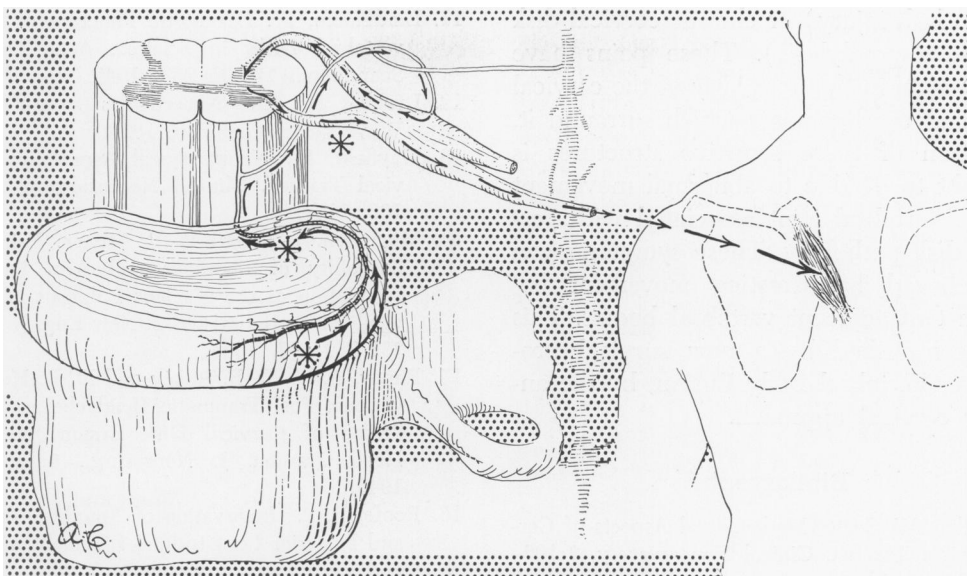


FIG. 6. Proposed pathway of nerve impulse from periphery of intervertebral disk to muscles of scapula via sinu-vertebral nerve. Diskogenic pain can be induced by stimulating areas marked (*) along this reflex arc.

pain which Frykholm⁶ elicited by handling the ventral cervical nerve roots intra-durally. He found that mechanical stimulation of ventral roots produced pain of a different character than that obtained from the dorsal root. It was described as "more deeply situated and referred to the proximal part of the limb, and shoulder girdle, predominantly to those muscle groups that had preoperatively been spastic or tender to pressure." Tender myalgic spots along the scapula may be explained on this basis, since electromyographic studies show disturbance in the muscles located at these trigger areas.

Pathways of the nerve impulse from the anterior surface of the disk to the scapular border are not known. It is possible that sensory receptors are in the branches of the sinu-vertebral nerve. The impulse would then pass through the spinal cord as a reflex arc and out the ventral root as a painful stimulus to the muscles of the shoulder girdle (Fig. 6). If this pathway is correct, then clinical symptoms of neck, shoulder and arm pain from cervical disk lesions can be attributed to irritation of the

sensory nerves located in the confines of the disk and its ligaments. If this irritation or stimulation results from hypermobility of the diseased joint due to rupture or degeneration of the disk, then it should be possible to relieve these pains by immobilization of the joint. This was accomplished by a new operation in which the vertebral bodies are fused through an anterior surgical approach after first removing the pathological disk and osteophytes.⁸

Summary and Conclusions

Sensory nerve endings in the lower cervical intervertebral disks and their ligamentous confines have been shown to be responsible for the clinical symptoms of pain in the neck, scapula, shoulder and upper arm. The origin of these referred pains has been determined by injection of the disk for diskography and by direct stimulation at operation. The pain itself is thought to be due to local reflex spasm (myalgia) of the muscles of the shoulder girdle. Pains referred to the neck, shoulder and arm are encountered in patients with acute injuries to the cervical spine

(whip lash injury) or chronic cervical disk disease (spondylosis). These pains have their origin in the periphery of the cervical disk and the ligaments which surround it. Irritation of these sensitive structures is thought to be due to abnormal movement of the vertebral joint associated with cervical disk pathology. These symptoms can be relieved by arresting movement between two adjacent vertebral bodies. This is accomplished by a new surgical procedure, Vertebral Body Fusion, by the anterior cervical approach.

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